published observations represent upwards of 2,000 single measures (*vide Memoirs*, vol. xxxii. p. 93). Of his later observations made after 1864, only the normal place for 1870–1 seems to have become publicly known. It is to be hoped that he may have been able to watch and observe the comes of his favourite double star through the most interesting portion of its orbit; but with the star so near the horizon and with a 4-inch telescope, the task cannot but have been beset with considerable difficulties. Mr. Powell will have deserved all the more credit and honour. It might fairly have been expected that observers who are provided with better instruments, and are far more favourably placed for observing *a Centauri*, would have rejoiced at having the opportunity of observing it just during those years when the observations are of the highest permanent value. If Mr. Powell's orbit and remarks were not sufficient to attract their attention, a glance over the Ephemeris deduced by Mr. Hind from Powell's elements, and published in the *Monthly Notices* for November 1872, vol. xxx. page 54, might have shown them the lucky and important chance within their grasp. The observations need not have interfered with other work, as they demand no fixed days and hours, and might have been made in daytime. But it seems that the most favourable time and opportunity has been allowed to slip away unused. However, as a couple of position-angles which Lord Lindsay has obtained in 1874 during his Mauritius expedition, are said to indicate that the comes of *a Centauri* is more than half a year behind its predicted position, the Southern observers may have a chance of regaining a portion of their neglected opportunities; and I suggested, therefore, that their personal friends should call their attention to the matter. But as you and other members of the Council have expressed the opinion that it would be better that I should put my remarks on paper for the *Monthly Notices*, I defer to your and their opinion, and I place accordingly these lines at your disposal, in the hope that they may be of some service.

1876, *December* 13.

A Preliminary List of Binary and other interesting Double Stars.

By J. M. Wilson, Esq., M.A., and J. Gledhill, Esq., F.R.A.S.

The following list is intended to be the basis of a working List of Binary and other interesting Double Stars, of which it is desirable to have accurate measures at not very distant intervals of time; and we think it may be of assistance to those observers who take up this branch of astronomy to have such a list for their guidance. We publish it also, with the hope that it may attract the attention of those who have specially devoted themselves to the measurement of binary stars, and that they will by their criticisms point out any errors that may exist in it, of

omission or otherwise. It is our intention to offer to the Society, at no distant period a list of binaries and other interesting double stars, with all the measures of them, that have been published up to the present date, extracted from the various Memoirs, Transactions, Journals, etc., which an astronomer must now consult if he wishes to ascertain the past history of a binary star and compute its orbit. It is plainly desirable that this list should be as complete as possible, and we shall be greatly obliged to any one who will point out to either of us any omissions in this preliminary list.

With a view to this work, we formed, some years ago, a list of double stars for observation, selected from those observed by Σ, OΣ, Mädler, Dawes, Dembowski, Secchi, and others, and have measured them, in order to ascertain, in all doubtful cases, whether there was sufficient evidence of appreciable change having taken place since the earliest measures. In this way we have been enabled to strike off many that were classed as probable binaries by Mädler and Secchi, and have ascertained that others are in motion which were not previously given in lists of such objects. Clearly, however, no list published now, however perfect, can possibly be final; it can do no more than represent knowledge up to the present date.

In addition to the well-known Lists of Double-Star Measures, we have been enabled, at the request of the Rev. R. Main, to obtain from Herr Otto von Struve the yet unpublished Part I. of his forthcoming great work on Double Stars. The Part received contains the Pulkova measures of Σ's Double Stars. Part II., containing the re-examination of OΣ's own discoveries, is expected shortly. We have found this work of very great help in deciding several doubtful points.

The numerous close pairs discovered by Mr. S. W. Burnham, of which measures have been published, will be entered on this list. There can be but little doubt that these interesting and difficult stars will shortly yield a rich harvest of binaries.

A few words on the form of the list may here be given. The first column contains the reference number; the second, the name of the star; the third, Σ's or OΣ's number (the latter in brackets) where the star has been observed by either; the fourth, the number in Sir John Herschel's great Catalogue, lately edited by the Rev. R. Main and Prof. Pritchard.

In conclusion, the points on which we request information are—

(1) Binaries omitted which it is thought should appear in such a list.

(2) Criticisms on the insertion of any stars which it is thought should be omitted.

(3) Unpublished measures or orbits of any binary stars.

Communications may be sent to J. M. Wilson, Temple Observatory, Rugby; or to Mr. J. Gledhill, Mr. E. Crossley's Observatory, Halifax.

No.	Name of Star.	Σ's No.	H's No.
1	Cephei 316 (B)	2	2
2	... ...	[2]	35
3	Cephei 318 (B)	13	48
4	... ...	16	58
5	... ...	[4]	59
6	... ...	23	66
7	26 Andromedæ	[5]	76
8	42 Piscium ...	27	103
9	Cassiopeiæ 49 (B)	30	127
10	49 Piscium ...	32	156
11	λ Cassiopeiæ ...	[12]	162
12	... ...	[18]	242
13	η Cassiopeiæ ...	60	283
14	... ...	69	307
15	36 Andromedæ...	73	319
16	P. O. 251 ...	80	344
17	... ...	86	373
18	Ceti 160 (B) ...	91	393
19	Polaris ...	93	400
20	... ...	[24]	407
21	... ...	[28]	430
22	... ...	102	453
23	42 Ceti ...	113	474
24	... ...	118	502
25	... ...	122	514
26	... ...	125	515
27	... ...	132	542
28	Andromedæ 219 (B)	133	543
29	P. I. 123 ...	138	568
30	... ...	142	588
31	... ...	[35]	606
32	... ...	158	637
33	... ...	175	677
34	... ...	183	704
35	... ...	185	710
36	P. I. 209 ...	186	714
37	... ...	196	738
38	α Piscium ...	202	753
39	γ Andromedæ ...	[38]	755

No.	Name of Star.	Σ's No.	H's No.
40	10 Arietis ...	208	761
41	... ...	221	799
42	Andromedæ 259 (B)	228	818
43	66 Ceti ...	231	821
44	... ...	234	827
45	... ...	257	892
46	ι Cassiopeiæ ...	262	906
47	... ...	278	949
48	84 Ceti ...	295	1009
49	θ Persei ...	296	1010
50	γ Ceti ...	299	1019
51	Arietis 114 (B)	305	1036
52	... ...	312	1044
53	π Arietis ...	311	1047
54	Persei 85 (B) ...	314	1053
55	... ...	[48]	1058
56	... ...	326	1080
57	... ...	328	1084
58	ε Arietis ...	333	1098
59	... ...	334	1104
60	Persei 104 (B)...	336	1109
61	Procyon		
62	... ...	[50]	1132
63	... ...	355	1147
64	... ...	367	1179
65	... ...	377	1210
66	... ...	380	1222
67	... ...	388	1240
68	... ...	400	1270
69	... ...	403	1271
70	... ...	408	1279
71	7 Tauri ...	412	1288
72	P. III. 98 ...	422	1308
73	... ...	447	1370
74	P. III. 165 ...	[64]	1387
75	Cephei 49 (Hev.)	460	1406
76	32 Eridani ...	470	1436
77	P. III. 242 ...	[531]	1486
78	... ...	511	1528

No.	Name of Star.	Σ's No.	H's No.
79	... ...	[78]	1540
80	40 Eridani ...	518	1553
81	... ...	[79]	1571
82	... ...	[80]	1582
83	Tauri 230 (B) ...	535	1600
84	... ...	[82]	1602
85	... ...	[85]	1677
86	2 Camelopardali	566	1687
87	... ...	567	1690
88	... ...	577	1715
89	... ...	615	1831
90	... ...	619	1842
91	5 Aurigæ	[92]	1844
92	... .	[93]	1862
93	... ...	629	1871
94	Camelopardali 19 (Hev.)	634	1892
95	P. IV. 288 ...	[95]	1897
96	... ...	[97]	1903
97	14 Orionis (*i*) ...	[98]	1923
98	... ...	644	1925
99	... ...	[100]	1941
100	... ...	651	1947
101	λ Aurigæ ...	...	1991
102	... ...	676	2001
103	... ...	677	2005
104	η Orionis ...	...	2071
105	... ...	712	2091
106	32 Orion's ...	728	2133
107	Tauri 380 (B) ...	742	2165
108	θ¹ Orionis ...	748	2178
109	... ...	749	2182
110	... ...	[112]	2190
111	ζ Orionis ...	774	2235
112	... ...	3115	2237
113	... ...	853	2462
114	... ...	861	2475
115	4 Lyncis ...	881	2527
116	... ...	932	2695
117	... ...	945	2730

No.	Name of Star.		Σ's No.	H's No.
118	54 Aurigæ	...	[152]	2734
119	12 Lyncis	...	948	2749
120	...	...	3117	2757
121	...	...	[154]	2766
122	...	...	[155]	2785
123	...	...	[156]	2795
124	Sirius	...	...	2799
125	14 Lyncis	...	963	2802
126	...	...	[157]	2811
127	13 Lyncis	...	[159]	2851
128	...	...	[161]	2869
129	38 Geminorum (e)		982	2872
130	μ Canis Majoris		997	2899
131	Σ 1037	...	[166]	3012
132	...	...	1049	3040
133	P. VII. 52	...	[170]	3068
134	δ Geminorum	...	1066	3084
135	...	...	1071	3092
136	...	...	1074	3103
137	...	...	1076	3107
138	...	...	1081	3121
139	...	...	1091	3158
140	...	...	1093	3161
141	...	...	1104	3214
142	Castor	...	1110	3228
143	P. VII. 170	...	1126	3297
144	κ Geminorum	...	[179]	3321
145	...	...	1136	3340
146	...	...	1142	3354
147	...	...	1157	3420
148	...	...	[186]	3482
149	Lyncis 85 (B)	...	1187	3533
150	ζ Cancri	...	1196	3557
151	P. VIII. 13	...	1202	3572
152	...	...	1216	3646
153	...	...	[193]	3696
154	...	...	1263	3832
155	ε Hydræ	...	1273	3868
156	...	...	1287	3907

No.	Name of Star.	Σ's No.	H's No.
157	ι Ursæ Majoris	[196]	3943
158	... ...	1300	3970
159	σ² Ursæ Majoris	1306	3989
160	... ...	1316	4021
161	... ...	1321	4046
162	... ...	3121	4083
163	Lyncis 157 (B)...	1338	4101
164	... ...	[200]	4123
165	... ...	[201]	4128
166	Hydræ 116 (B)...	1348	4139
167	ω Leonis ...	1356	4165
168	Hydræ 134 (B)...	1365	4190
169	P. IX. 161 ...	1377	4253
170	φ Ursæ Majoris	[208]	4290
171	... ...	1385	4294
172	... ...	1389	4305
173	8 Sextantis ...	A.C. 5	4314
174	... ...	1406	4387
175	... ...	[213]	4429
176	P. X. 23 ...	[215]	4449
177	γ Leonis ...	1424	4469
178	Leonis 145 (B)...	1426	4477
179	... ...	1439	4536
180	... ...	1457	4606
181	P. X. 128 ...	[224]	4612
182	... ...	1472	4669
183	... ...	[228]	4671
184	... ...	[229]	4690
185	... ...	1486	4714
186	... ...	[230]	4717
187	54 Leonis ...	1487	4719
188	... ...	1500	4754
189	P. X. 229 ...	1504	4782
190	... ...	1514	4820
191	[539] ...	1516	4833
192	P. XI. 9 ...	1517	4834
193	ξ Ursæ Majoris	1523	4860
194	... ...	1534	4885
195	ι Leonis ...	1536	4896

No.	Name of Star.	Σ's No.	H's No.
196	57 Ursæ Majoris	1543	4924
197	... ...	[234]	4934
198	... ...	[235]	4942
199	P. XI. 111 ...	1555	4978
200	... ...	[237]	5000
201	... ...	1588	5141
202	... ...	3123	5167
203	... ...	1607	5205
204	Comæ Ber. 68 (B)	1639	5293
205	... ...	1641	5296
206	... ...	1644	5307
207	Virginis 191 (B)	1647	5319
208	... ...	1658	5341
209	... ...	1663	5354
210	γ Virginis ...	1670	5377
211	... ...	1678	5401
212	35 Comæ Ber. ...	1687	5430
213	... ...	[256]	5445
214	179 Comæ Ber.	1722	5515
215	42 Comæ Ber. ...	1728	5523
216	... ...	[261]	5535
217	... ...	1734	5570
218	... ...	1742	5590
219	... ...	1746	5608
220	72 Virginis l^1 ...	1750	5622
221	P. XIII. 127 ...	1757	5639
222	25 Canum Ven.	1768	5673
223	84 Virginis ...	1777	5704
224	... ...	1781	5726
225	τ Boötis ...	[270]	5737
226	... ...	1785	5754
227	P. XIII. 238 ...	1788	5789
228	[277] ...	1812	5894
229	... ...	1819	5907
230	... ...	1820	5913
231	Boötis 121 (B)...	1825	5922
232	... ...	1830	5933
233	... ...	1832	5934
234	P. XIV. 70 ...	1837	5964

No.	Name of Star.	Σ's No.	H's No.
235	... ...	1842	5987
236	... ...	1858	6040
237	... ...	1863	6062
238	π Boötis ...	1864	6066
239	ζ Boötis ...	1865	6069
240	... ...	1866	6072
241	... ...	1876	6099
242	ε Boötis ...	1877	6101
243	... ...	1879	6106
244	... ...	1883	6124
245	ξ Boötis ...	1888	6146
246	... ...	[287]	6159
247	... ...	[288]	6161
248	44 Boötis (*i*) ...	1909	6237
249	... ...	1925	6305
250	... ...	[295]	6311
251	5 Serpentis ...	1930	6327
252	Coronæ 1 (B) ...	1932	6331
253	... ...	1934	6336
254	η Coronæ ...	1937	6362
255	P. XV. 74 ...	1938	6371
256	... ...	1944	6382
257	... ...	[296]	6388
258	δ Serpentis ...	1954	6426
259	... ...	1957	6434
260	... ...	[298]	6446
261	... ...	1961	6440
262	γ Coronæ ...	1967	6469
263	... ...	1983	6523
264	... ...	1985	6535
265	18 π² Ursæ Minoris	1989	6547
266	... ...	[303]	6575
267	ξ Libræ ...	1998	6582
268	κ Herculis ...	2010	6610
269	49 Serpentis ...	2021	6634
270	... ...	2022	6640
271	... ...	2026	6645
272	σ Coronæ ...	2032	6654
273	Antares ...	...	6707

No.	Name of Star.		Σ's No.	H's No.
274	...	...	2049	6718
275	Draconis 99 (B)		2054	6723
276	λ Ophiuchi	...	2055	6727
277	ζ Herculis	...	2084	6799
278	...	...	2094	6816
279	...	...	2097	6823
280	21 Ophiuchi	...	[315]	6840
281	...	...	2106	6842
282	Herculis 167 (B)		2107	6847
283	...	...	3107	6867
284	...	...	[321]	6879
285	P. XVI. 270	...	2114	6888
286	20 Draconis	...	2118	6895
287	Herculis 210 (B)		2120	6910
288	μ Draconis	...	2130	6935
289	36 Ophiuchi	...	...	6946
290	δ Herculis	...	3127	6968
291	...	...	2145	6973
292	ρ Herculis	...	2161	7016
293	...	...	2165	7028
294	...	...	2173	7040
295	P. XVII. 163	...	2190	7076
296	...	...	2199	7104
297	...	...	2203	7108
298	...	...	2205	7128
299	...	...	2214	7129
300	...	...	2215	7130
301	μ Herculis (A. C. 7)		2220	7142
302	τ Ophiuchi	...	2262	7245
303	...	...	2267	7262
304	...	...	2271	7267
305	70 p Ophiuchi	...	2272	7273
306	73 Ophiuchi	...	2281	7309
307	Herculis 417 (B)		2289	7322
308	...	...	2294	7340
309	Lalande 33731	...	2303	7370
310	...	...	2311	7388
311	Herculis 452 (B)		2315	7406
312	39 Draconis, b	..	2323	7425

F

No.	Name of Star.		Σ's No.	H's No.
313	φ Draconis	...	[353]	7443
314	...	...	[358]	7479
315	α Lyræ	...	...	7501
316	...	...	2367	7523
317	...	...	2384	7563
318	ε¹ Lyræ	...	2382	7564
319	ε² Lyræ	...	2383	7566
320	...	...	2396	7593
321	...	...	2400	7604
322	...	...	2402	7609
323	...	...	2409	7625
324	*o* Draconis	...	2420	7660
325	[365]	...	3130	7670
326	...	...	2422	7671
327	11 Aquilæ	...	2424	7675
328	...	...	2429	7689
329	P. XVIII. 274	...	2434	7702
330	...	...	2437	7706
331	P. XVIII. 287	...	2438	7709
332	...	...	2441	7723
333	...	...	2454	7752
334	Lalande 35821	...	2455	7753
335	...	...	2464	7768
336	...	...	2471	7787
337	...	...	2481	7810
338	...	...	2484	7819
339	Cygni 6	...	2486	7828
340	...	...	2491	7854
341	...	...	2514	7922
342	P. XIX. 128	...	2521	7946
343	Cygni 22 (B)	...	2525	7958
344	...	...	2538	8006
345	P. XIX. 185	...	2541	8024
346	...	...	2544	8037
347	...	...	[378]	8061
348	...	...	2556	8079
349	...	...	[383]	8123
350	...	...	2574	8139

No.	Name of Star.	Σ's No.	H's No.
351	... ...	2576	8146
352	δ Cygni ...	2579	8153
353	... ...	[387]	8179
354	β Aquilæ ...	[532]	8228
355	Cygni 116 (B) [392]	2607	8274
356	... ...	2619	8313
357	θ Sagittæ ...	2637	8382
358	... ...	2640	8386
359	... ...	[400]	8411
360	... ...	2658	8457
361	P. XX. 178 [407]	2690	8600
362	... ...	2696	8624
363	β Delphini ...	2704	8663
364	κ Delphini ...	[533]	8674
365	... ...	2708	8692
366	... ...	[410]	8703
367	... ...	2725	8751
368	52 Cygni ...	2726	8755
369	λ Cygni ...	[413]	8773
370	4 Aquarii ...	2729	8784
371	... ...	2734	8812
372	ε Equulei ...	2737	8839
373	... ...	2744	8860
374	... ...	2746	8868
375	... ...	2749	8876
376	61 Cygni ...	2758	8898
377	... ...	2760	8902
378	δ Equulei [535]	2777	8959
379	... ...	2779	8965
380	P. XXI. 50 ...	[432]	8976
381	A. C. 19 ...	...	8998
382	... ...	2793	9048
383	... ...	[437]	9021
384	Pegasi 20 (B) ...	2799	9072
385	... ...	2801	9087
386	Pegasi 29 (B) ...	2804	9107
387	... ...	[443]	9134
388	... ...	[447]	9175

F 2

No.	Name of Star.	Σ's No.	H's No.
389	μ Cygni ...	2822	9210
390	... ...	2825	9226
391	... ...	2828	9240
392	... ...	2837	9273
393	... ...	2849	9333
394	... ...	2865	9416
395	P. XX. 11, 12 ...	2872	9442
396	P. XXII. 33 ...	2877	9469
397	Pegasi 148 ...	2878	9466
398	... ...	2895	9516
399	33 Pegasi ...	2900	9539
400	ζ Aquarii ...	2909	9580
401	37 Pegasi ...	2912	9593
402	... ...	2915	9614
403	... ...	2928	9670
404	... ...	2934	9703
405	... ...	2942	9736
406	P. XXII. 219 ...	2944	9742
407	... ...	[536]	9832
408	52 Pegasi ...	[483]	9840
409	... ...	2976	9901
410	... ...	2990	9946
411	94 Aquarii ...	2998	9982
412	o Cephei ...	3001	9993
413	... ...	3006	10004
414	... ...	3007	10015
415	P. XXIII. 69 ...	3008	10020
416	... ...	[500]	10117
417	... ...	3037	10170
418	... ...	3046	10235
419	37 Andromedæ (B)	3050	10258
420	Lalande 47206...	3056	10291
421	... ...	3062	10304
422	... ...	[523]	

The following stars, having common proper motion (see Struve's *Pos. Med.*) may, perhaps, be measured occasionally with advantage, and should therefore be inserted in the list. The distances are between 32″ and 7′: 40 *Eridani*, ψ *Aquarii*, 37 *Ceti*,

Regulus, 16 *Cygni*, *Castor*, ν^1, ν^2 *Draconis*, 1 *Pegasi*, ι *Boötis*, 93 *Leonis*, μ *Boötis*, θ^1, θ^2 *Tauri*, ϵ and 5 *Lyræ*, a *Tauri*, 6 and 8 *Vulpec.*, 16 and 17 *Draconis*, 33 and 34 *Ophiuchi*, a^1 and a^2 *Capricorni*; also P. III. 241 and 50 *Persei* (see O Σ and Argelander).

In addition to the above, a good many pairs, whose changes in angle and distance can be explained by the proper motion of the principal star, were long ago examined by Struve (*Pos. Med.*) Perhaps these should go into the list. Also the "higher systems" of Mädler would probably not be misplaced in it (see *Untersuchungen über die Fixstern-Systeme.*

Mr. E. Crossley's Observatory,
Bermerside, Halifax,
December 1876.

On an Oversight in the Mécanique Céleste, and on the Internal Densities of the Planets. By George H. Darwin, M.A., Fellow of Trinity College, Cambridge.

(*Communicated by J. W. L. Glaisher, F.R.S.*)

In the following paper an endeavour is made to point out an inconsistency, which appears to have escaped the notice of Laplace, in his determination of the precessional constants of the planets *Jupiter* and *Saturn*. From this I have been led on to speculate on the law of internal density of those planets, and of *Mars*, and to make some reference to the ellipticities of *Mercury* and *Venus*.

1. *Laplace's Law of the Internal Density of the Planets.*

In the investigation of the figure of the Earth, Laplace assumed that, in molten rock, the hydrostatic pressure *plus* a constant varies as the square of the density. The result of this assumption is that, after the consolidation of a planet, the density of any stratum of mean radius r is given by the law $\dfrac{F}{r} \sin \dfrac{r\theta}{a}$, where a is the mean radius of the surface, and θ and F are constants.

Throughout the rest of this paper, besides the foregoing, the following notation is used:—

a, β, the equatoreal and polar radii;
ϵ the ellipticity of the surface;
m the ratio of the centrifugal force of the planet's rotation at the distance a to the mean pure gravity;